UPPER PENITENCIA CREEK MODEL

Santa Clara Valley Water District

GB
1225
P45.U6
1975

82

GB1225P45U61975c.2

SANTA CLARA VALLEY WATER DISTRICT

UPPER PENITENCIA CREEK MODEL

by

Joe Pandit
Associate Civil Engineer

under the direction of
John Richardson
Head, Project Development Branch

George Korbay
Design and Construction Manager

John T. O'Halloran
General Manager

Lloyd C. Fowler
Chief Engineer

March 1975

DISTRICT BOARD OF DIRECTORS

JOE CHIRI	DISTRICT 1	JAMES J. LENIHAN	DISTRICT 5
PATRICK T. FERRARO	DISTRICT 2	COURTLAND M. RUSH , VICE CHAIRMAN	AT LARGE
ROBERT T. SAPP , CHAIRMAN	DISTRICT 3	EDMUND A. MIRASSOU	AT LARGE
MAURICE E. DULLEA	DISTRICT 4		

TABLE OF CONTENTS

Page

1. Introduction 1

2. Objective of the Model 2

3. Selection of the Creek Reach to be Modelled and the Type of Models 2

4. Meetings with Model Builders and Others 5

5. Alternative Proposals 7

6. Recommendations 11

UPPER PENITENCIA CREEK MODEL

1. Introduction

Upper Penitencia Creek originates at an elevation of about 2600 feet, msl, in the eastern hills of Santa Clara County near Poverty Ridge and flows west. At Alum Rock Park, it confluences with Arroyo Aguague which is a major tributary to the creek. From there it continues its westward flow and passes through urbanized and agricultural areas of the valley until it confluences with the Coyote Creek, near Bayshore Freeway. The total drainage area of the creek is 24 square miles and the one percent design flood for the reach between Alum Rock Park and the confluence with Coyote Creek is 5600 cubic feet per second. The existing creek channel in this reach is inadequate to carry the one percent flood and will generate substantial flooding.

The Upper Penitencia Creek Improvement Plan was one of the projects in the East Zone Planning Study that was presented to East Zone residents in 1973. In explaining the District's proposed improvement plans to the public, the staff used many two-dimensional visual aids such as slides, sketches, engineering maps, etc. However, in reviewing the effectiveness of our presentations, it appears that a three dimensional model would assist in communicating our plans to the public. After general discussion with the Board of Directors the staff was requested to explore further the feasibility of constructing such a model and obtain definitive cost estimates.

2. Objective of the Model

The purpose of having a three-dimensional physical model of the creek is to add an important tool in translating District plans into a visual object which could be easily comprehended by the public. Further, such a model would help demonstrate to the public how the District strives to integrate their flood control facilities with the urban environment in a manner to minimize the impact. This model could also be utilized to demonstrate fruitful integration of flood control facilities of the District and the recreation facilities of the City of San Jose for the proposed Penitencia Creek park chain.

3. Selection of the Creek Reach to be Modelled and the Type of Models

The flood-prone area resulting from overbanking flood flows from Upper Penitencia Creek is confined to the reach between Alum Rock Park and the Coyote Creek. The proposed Penitencia park chain also would cover this reach. Therefore, to demonstrate the existing and the post-project flooding conditions and recreation facilities, this reach (about 24,000 feet long) was considered for detailed modelling. In addition, this model could be supplemented by a small scale topographical model of the entire watershed for a better overview of basin characteristics.

Since the primary purpose of building the model is to demonstrate flooding conditions, the original consideration was to construct a hydraulic model with running water in it. However, there are certain hydraulic and practical problems associated with such a model. They are as follows:

a. The model should be portable so that it can be carried to various public meetings. With this in mind, 1 inch = 200 feet is the largest scale that can be used for modelling a 24,000-foot-long reach of the creek. With this scale, the proposed model would be about 10 feet long. However, if the model is undistorted (that is, it has identical vertical and horizontal scales), the depth of flow in the model would be very small (between 1/16 inch and 1/32 inch). The surface tension and frictional forces would then be significant compared to the prototype (existing creek) where gravitational forces are predominant. Consequently, the hydraulic characteristics of the model and the prototype would not be comparable. The flooding boundaries in the field and model would consequently be significantly different.

b. Next, if the model is undistorted, the roughness of the model will have to be much smoother than the prototype. As for example, for a model scale of 1 inch = 200 feet, the Manning roughness coefficient for the model should be only 0.27 times that of the prototype. It would be difficult to find a smooth-textured material that could meet this criteria.

c. The depth of flow in a model could be increased by using distorted scales, that is, a vertical scale several times larger than the horizontal scale. In this case the roughness of the model would be required to be larger than the prototype or the field conditions. However, great care is necessary in simulating model roughness especially when overbank flows are significant as compared to channel flows, as for example during a 100-year flood. A distorted scale model while effective hydraulically would not serve the visual relationship requirement to show the public what the proposal would look like.

d. Any type of hydraulic model would have to be "proved", that is, it would require calibration of the model to correspond to field conditions. For this purpose, some past floods are selected and corresponding field levels are determined. Then the model roughness is adjusted so as to reproduce the field conditions in the model. This problem of calibration is a trial and error procedure and would probably be prohibitive in cost to undertake.

e. One of the model builders consulted pointed out that models slightly deform under changing environmental conditions of temperature and humidity. An even slightly deformed hydraulic model would probably produce significantly different flooding patterns from those that would actually occur in the field because of the vast scale difference between model and prototype.

f. Even if a hydraulic model were built, it would be necessary to adjust the base level of the model every time it was carried to a public meeting. This would be a time consuming procedure. If the base level of the model were not properly adjusted, the flooding pattern would be different from what it really should be, again, due to the vast difference in scale.

Considering these factors, the construction of a hydraulic model is not recommended. However, the value of a display model is recognized and the following discussions relate to such a proposal.

4. Meetings with Model Builders and Others

The following were consulted in order to discuss the required number of model units, model scales, construction material, graphic details, model building time, range of costs and other related information.

- Mr. Nick Neklason, Model Building Instructor at West Valley College
- Mr. John Guisto of San Jose City's Parks and Recreation Department
- Mr. Don Nusbaum of Scale Models Unlimited, Menlo Park
- Mr. Calvin Amai of Architectural Models of San Francisco
- Mr. Chris Dutch, a private model builder

Following is a brief summary of our discussions.

a. Mr. Neklason advised that the District should not consider utilizing West Valley student help because students may not have adequate training or tools for building the model.

b. A single small scale model covering the entire reach of the creek would not be adequate to present all the details. It would have to be supplemented with separate models of areas that require more detail. In addition, a topographical model of the entire watershed would be very useful during public presentations.

c. The construction material normally would be rigid or laminated lightweight foam material.

d. The graphics of creek, landscaping, urban facilities, subdivisions, streets, etc., could be well represented on a model. However, on small scale models, the houses could only be reproduced by a symbolic structure, that is the exact floor plan could not be reproduced. A model of a cross section could be used to express a more exact relationship between creek improvements and neighboring properties.

e. The flooding boundaries could be shown by a built-in lighting system, or a color tape or by color shading the flood-prone area.

f. Starting from date of order, the delivery time of the model could vary from 4 to 6 weeks.

g. For an ease in transport, the length of the model or models should not exceed 8 feet. If larger than 8 feet, it would be desirable to have the models in two pieces.

h. The scale of the model of the reach between Alum Rock Park and Coyote River could vary from 1 inch = 200 feet to 1 inch = 500 feet and that of sections could vary from 1 inch = 10 feet to 1 inch = 50 feet. The watershed model could be built to 1 inch = 1000 feet scale. The vertical scale of such a model could be distorted to 1 inch = 500 feet to provide better vertical resolution.

i. The cost of the model would probably range from $100 to $150 per square foot. The cost of cross sections would probably vary from $500 to $700 each.

As mentioned previously, the City of San Jose has a proposal to develop a park chain along the Penitencia Creek. The proposed model could also be used to demonstrate their proposed recreational facilities. Mr. John Guisto advised that his staff has experience in preparing plans, drawings and other details for model building and the City would provide staff assistance if the District decided to go ahead with the project.

5. Alternative Proposals

Following are the three alternative proposals that might be considered for modelling the reach of the Penitencia Creek between Alum Rock Park and Bayshore Freeway.

Alternative 1 - This plan considers building a 1 inch = 200 feet scale model of the reach and supplement this model with three to four models of typical cross sections at 1 inch = 20 feet scale. The flooding boundaries, streets, symbolic housing units and landscaping would be shown on the main model. The cross section models would cover about a 600-foot-wide strip and show the proposed improvements and their relationship to neighboring urban and agricultural areas. Using the proposed scale, the main model would be about 120 inches long and 36 inches wide and the cross sections would be about 27 inches long and 30 inches wide. The estimated cost of this alternative is about $9,500, if all the details are to be modelled. The cost, however, could be reduced to about $7,500 if only limited detailing of buildings and trees is utilized.

The advantages of this alternative are as follows:

a. The scale of 1 inch = 200 feet is half of the scale normally used in our project drawings, so it would be easy to relate objects on the model and drawings.

b. The entire critical reach would be on the model and as a result it would be easier to visualize overall flooding conditions.

The disadvantages of this alternative are as follows:

a. Transportation of a 10-foot-long model would be a problem. The model could be cut in two pieces to reduce its size. However, frequent transportation and setting up of the blocks could damage edges and corners at the junction of the two pieces.

b. Cross sections cover only a 600-foot-wide strip and the probable 100-year flood width would exceed this in certain areas.

Alternative 2 - This plan considers building a set of models for a slightly shorter reach of creek as compared to that in Alternative 1. The scale of the models would be the same as in Alternative 1, that is, 1 inch = 200 feet. The size of both the models would be 8 feet x 2 feet. The first model will demonstrate the existing environment and flooding conditions and the second model would show the proposed project improvements and resulting change in flooding conditions. These two models would be supplemented with three to four cross section models at a scale of 1 inch = 20 feet. The cost estimate of this alternative is about $9,500, assuming that only limited building and tree detailing would be performed.

The advantages of this alternative are as follows:

a. The models of the cross section in all the alternative plans would show the proposed flood control improvements. However, the cross sections would cover only a very short reach along the creek, and the areas in the immediate neighborhood of the creek. Further, the proposed models of the entire reach under the other alternative plans would show only the existing flooding conditions. Consequently, the models proposed under other alternative plans would provide only partial vision of the post-project conditions. The two models of the entire reach between Alum Rock Park and Bayshore Freeway, as proposed in this alternative plan, when set side by side, would provide an excellent comparison of pre and post-project conditions.

b. As in Alternative 1, the model scale would be half the drawing scale.

c. It would be slightly easier to transport an 8-foot x 2-foot model as compared to the 10-foot x 3-foot model of Alternative 1.

The disadvantages are as follows:

a. Unlike Alternative 1, two models are proposed which would increase costs by about $2000 over that of Alternative 2.

b. The scale of the model of the entire reach would be so small that project improvement could not be very effectively shown on the model. Consequently, as in Alternative 1, models of several cross sections should be built.

c. Transportation of the model would be difficult.

Alternative Plan 3 - This plan proposes that a generalized model be constructed at a scale of 1 inch = 400 feet for the 24,000-foot-long reach from the Alum Rock Park to the Bayshore Freeway. The model would cover about 3600 feet on either side of the Penitencia Creek. The size of this model would be about 18 inches x 60 inches. All topographic features, site detailing, roads, creek detailing and related elements would be portrayed. The flood-prone areas would also be shown on this model by use of color shading.

Under this alternative plan, it is also proposed that four additional models at 1 inch = 20 feet scale be constructed to depict the detailed post-project conditions. These models would cover about a 600-foot-wide and 800-foot-long strip of the channel. The detailing would include topographic features, the creek, the proposed channel modifications, structures (actual floor plan) and detailed landscaping. The cost estimate of this plan is about $8,000.

The following advantages could be attributed to this alternative.

a. The models would be easy to transport.

b. The large scale models of the critical reaches would better show the pre and post-project plans.

Alternative Plan 4 - This plan is identical to Plan 3 in all respects except instead of four detail models (scale 1 inch = 20 feet) of flood control improvements called for in Plan 3, it is proposed to build only two detail models. This modification would reduce the cost of this plan to about $6,000.

Watershed Model - A large portion of the drainage area is located upstream of Alum Rock Park and is the area that contributes most of the flood waters. It is difficult for many to visualize this without some type of an overview model of the entire watershed. A simple topographical model of the entire watershed could be built to complement the models proposed under Alternatives 1, 2 or 3. Such a watershed model would cost about $700, and we recommend this be included with whichever alternative is selected.

6. Recommendations

a. The modelling system described in Alternative 4 should be authorized for construction.

b. This system should be supplemented with a model of the entire watershed.